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The polarization of the stars in ~~the~~ open clusters, explained on the basis of the Davis-Greenstein theory, gives some information on the microstructure of the galactic magnetic field.

The polarization is most conveniently described by the parameters Q, U, proportional to the Stokes parameters and defined by

$$Q = p \cos 2(\vartheta - \bar{\vartheta})$$
$$U = p \sin 2(\vartheta - \bar{\vartheta})$$

where p is the amount of polarization, ϑ is the position angle of the electric vector and $\bar{\vartheta}$ is the mean value of ϑ for the region under consideration.

The parameters Q, U, may be represented as the integrals over the light path of some simple functions of the density of polarizing matter and of the components of galactic magnetic field. We introduce two models: in the first model ~~the~~ isotropic fluctuations are superimposed upon the homogenous general magnetic field; in the second model ~~the~~ fluctuations perpendicular to the mean direction of the field are superimposed upon the homogeneous field. ~~[illegible]~~ Alfvèn wave is running in the direction of the general field, ~~can be represented by~~ the latter model might be correct if an

For each of these models the ratio of the variances of the parameters Q, U, is computed for the group of stars lying in the same distance in the direction approximately perpendicular to the direction of general field. Thus for the first model we have

$$\sigma_Q^2/\sigma_u^2 = 1 + C^2 > 1 \quad (1)$$

while for the second model

$$\sigma_Q^2/\sigma_u^2 = \frac{1}{4} \alpha_1^2 + C^2 \quad (2)$$

where α_1 is the root-mean-square angular deviation of the magnetic lines of force from a uniform direction and C^2 is a positive constant.

The 92 stars with the radius of 2° around the Double Cluster in Perseus for which the polarization was measured by Hiltner [1] give

$$\sigma_Q^2/\sigma_u^2 = 0.65 \pm 0.14 \quad \text{(m.e.)} \quad (3)$$

This value was obtained after eliminating the dependence of the amount of polarization p on the galactic latitude b ; this dependence was represented by the linear formula

$$p = 0\overset{m}{.}115 - 0\overset{m}{.}012\,|b| \,. \quad (4)$$
$$\pm 7 \qquad \pm 2$$

since the ratio (3) is smaller than unity it cannot be

explained by the first model assuming the isotropic fluctuations of magnetic field. On the other hand the ratio (3) can be represented by the formula (2) on the assumption that the Alfvèn wave is running in the direction of general field.

The distribution of the values of parameters Q, U, over the area of the Double Cluster was used to evaluate the micro-scale of the fluctuations in the factors responsible for the interstellar polarization. On the assumption that the properties of interstellar medium are the same everywhere along the way to the Double Cluster the micro-scale of about 1,5 pc was obtained : this micro-scale is the distance over which the autocorrelation coefficient falls to 1/e (the above result was presented by this author during the Stockholm Symposium on Electromagnetic Phenomena in Cosmical Physics).

With the above value of the micro-scale and with the variances σ_Q^2, σ_U^2, obtained from the polarization measurements for the Double Cluster the root-mean-square angular deviation of the magnetic lines of force from the uniform direction is

$$\alpha_1 = 0.71 \pm 0.06 \quad (\text{m.e.}) \qquad (5)$$

while the ratio of the mean-square deviation in the density of polarizing matter to the square of the mean density is

$$\overline{(\rho - \bar{\rho})^2}/\bar{\rho}^{\,2} = 13 \qquad (6)$$

The value (6) obtained from the polarization data agrees fairly well with the value $\overline{(\rho - \bar{\rho})^2}/\bar{\rho}^{\,2} = 15$ obtained from the analysis of the reddening of the Double Cluster [2].

If in the magneto-hydrodynamic formula given by Davis [3] and by Chandrasekhar and Fermi [4]

$$B = (4\pi \rho/3)^{1/2} v/\alpha_1 \text{ gauss}$$

one takes the value (5) for α_1 and according to Spitzer [5] the density of gas $\rho = 2 \cdot 10^{-24}$ gm per cm^3 and its root-mean-square velocity $v = 12$ km per sec one gets the strength of magnetic field

$$B = 5 \cdot 10^{-6} \text{ gauss}$$

what is not discordant with value $B = 3 \cdot 10^{-6}$ gauss obtained by Spitzer [5] from the condition that the gravitational pressure equals the sum of material and magnetic pressures.

If we consider the stars in the radius of e.g. 45 minutes of arc around the Double Cluster there is no correlation between the polarization and reddening (fig.1). The same result is obtained if all the stars in the radius of 2° around the centre of the Double Cluster are considered after eliminating the dependence of the ... means of formula (4) and of the reddening E by means of similar formula

$$E_{B-V} = \underset{\pm 4}{0^{m}.97} - \underset{\pm 1}{0^{m}.13}\,|b| \tag{7}$$

In this case the coefficient of correlation between p and E_{B-V} is 0.08 ± 0.12 .

The similar lack of correlation between the polarization and reddening is stated for the heavily obscured association of OB stars in Cygnus observed by Hiltner [6] and also for the cluster in Perseus discovered by Stock [7] (see fig.2); the polarization of this cluster was measured photoelectrically by Larsson-Leander and the present author [8] . Among the 5 clusters observed by Hoag [9] all except NGC 663 do not show any correlation between polarization and reddening. The clusters NGC 663 and M29 for which the polarization is strongly correlated with reddening are probably (according to suggestion by Hiltner [10]) embedded in dense nebulae in which an appreciable part of observed polarization and reddening is produced.

On the assumption that the same particles of dust are responsible both for the polarization and reddening and that the polarizing properties of the dust are not dependent on its spatial density the correlation coefficient between the polarization and reddening in the cluster should be equal to

$$r = \left(\frac{\sigma_E}{\bar{E}}\right) / \left(\frac{\sigma_p}{\bar{p}}\right) \tag{8}$$

where $\sigma_E / \bar{E}$ is the ratio of root-mean-square deviation in reddening to the mean reddening and $\sigma_p / \bar{p}$ is the corresponding ~~ratio~~ for the amount of polarization.

For the Double Cluster the observations show that $(\sigma_E/\bar{E}) > (\sigma_p/\bar{p})$ and hence formula (8) gives the correlation coefficient greater than unity while the observations show no correlation. It means that ~~xx~~ our assumptions were wrong and that the spatial density of particles responsible for interstellar polarization is uncorrelated with density of the particles responsible for the reddening.

This effect can be explained by the assumption that in the H II regions the light is polarized much more effectively than in the H I regions, where the spatial density of dust is greater. ~~It can be caused e.g. by the greater angular momentum of rotating dust particles and hence their better alignment in the ionized regions in which the temperature of gas is higher.~~

Besides the lack of correlation between the polarization and reddening of the stars in clusters there are two another arguments which support the hypothesis that the polarization is produced [illegible] in the ionised regions: the first one is obtained from the comparison of the values of polarization and reddening for the Stock cluster with those for the Double ~~second~~ Cluster, while the second argument is supplied by the dependence of the ratio of polarization to reddening on the galactic latitude.

The Stock cluster lies only 2° north from the Double Cluster but in the distance of about 300pc i.e. nearly 8 times smaller than the distance of the Double Cluster. Nevertheless the reddening in the B-V system is for the Stock cluster $0^m.74$ thus being greater than for the Double Cluster for which the corresponding value is $0^m.58$. On the other side the mean amount of polarization for the Stock cluster is $0^m.050$ which is much smaller than for the Double Cluster for which $\bar{p} = 0^m.080$.

For the 3 stars (HD 13402, BD+58°400 and BD+59°451, lying in the distance of about 2[redacted]kpc behind the Stock cluster the mean reddening is $0^m.90$ and the mean polarization is $0^m.118$ according to Hiltner [15]. Hence only about 20 per cent of the observed reddening and nearly 60 per cent of the observed polarization of these stars is produced in the distances greater than the distance of the Stock cluster i.e. between the spiral arms of the galaxy. It may indicate that in the space between the spiral arms where the clouds of neutral hydrogen are not numerous the ratio of polarization to reddening is very high.

This conclusion is supported ~~supplied~~ by the data on the dependence of the ratio of polarization to reddening on the galactic latitude given in the table below.

THE DEPENDENCE OF THE RATIO OF POLARIZATION TO REDDENING ON THE GALACTIC LATITUDE

$\lvert b \rvert$	$b < 0°$	$b > 0°$
0°.0 to 2°.0	0.162 ± 0.005	0.164 ± 0.006
2°.1 to 5°.0	0.217 ± 0.008	0.194 ± 0.006
5°.1 to 10°.0	0.186 ± 0.016	0.215 ± 0.006

The data given in the table are based on 930 stars for which both polarization ([1], [11], [12]) and reddening were measured photoelectrically. The reddenings are in the system of Stebbins, Huffer and Whitford [13] with the intrinsic colour from Morgan, Harris and Johnson [14] . Only the stars with reddenings greater than $0^m.05$ were used.

It can be seen from the table [illegible]

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